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WATERPROOFING AND DEODORIZING SHEET MATERIAL

Inventors:

Toshimasa Igari
Kogyo Gijyutsuin
Chemical Technology
Research Center,
1-1 Tadabe-cho, Higashi
Tsukuba-gun,
Ibaragi-ken

Seiichiro Yokoyama
Kogyo Gijyutsuin
Chemical Technology
Research Center,
1-1 Tanidabe-cho, Higashi
Tsukuba-gun,
Ibaragi-ken

Keisuke Kato
56-37 Gotanda,
Kamiyuhase-cho
Tokiwa, Iwaki-shi

Chiaki Ohama
Minato Sangyo K.K.
1-13-2 Higashiazabu,
Minato-ku, Tokyo-to

Ryousuke Fukui
Minato Sangyo K.K.
1-13-2 Higashiazabu,
Minato-ku, Tokyo-to

Applicants:

President, Kogyo
Gijyutsuin
[no address given]

Minato Sangyo K.K.
8-12-9 Ginza, Chuo-ku
Tokyo-to

Sub-Agent:

Toshizo Iida, patent
attorney

Kunimine Kogyo K.K.
1-10-5 Iwamoto-cho
Chiyoda-ku, Tokyo-to

Agent: Toshizo Iida,
patent attorney

[Attached amendments have been incorporated into text of translation.]

Claims

1. A waterproofing and deodorizing sheet material characterized by adhering and fixing a highly water-absorbent gelling substance in granular form, composed of an iron(II) compound combined with L-ascorbic acid, between sheets of material penetrable by water.

2. The waterproofing and deodorizing sheet material described in Claim 1 with the highly water-absorbent gelling substance being an inorganic substance.

3. The inorganic substance in the waterproofing and deodorizing sheet material described in Claim 1 being bentonite.

4. The highly water-absorbent gelling substance in the waterproofing and deodorizing sheet material described in Claim 1 being an organic polymer.

Detailed explanation of the invention

Field of technology to which the invention belongs

This invention concerns sheet material with excellent deodorizing property, as well as rapid expansion activity through absorption of water and the forming of a minute waterproofing layer.

Existing technology

Special construction, such as the installation of synthetic sheets and water-resistant asphalt layers, for example, was previously performed in order to prevent water leakage in both floors and attics in the construction of houses and offices.

On the other hand, air purification systems and deodorization systems equipped with various types of large-scale to small-scale deodorizing functions have been developed expressly to purify the air in houses and offices, for example.

Problems to be solved by the invention

However, the aforementioned existing waterproofing methods in construction required much labor and cost. The waterproofing function in the waterproof material itself is perfect but lacks or has very poor moisture permeability and water absorption, therefore problems occurred in our country of high temperatures and moisture, such as formation of dew condensation on the surface of the waterproof material, or growth and propagation of

fungus, and this was not satisfactory. Moreover, it was difficult to add the deodorizing function to this type of waterproof material.

The aforementioned purification systems equipped with various types of deodorizing functions are being used with the intention of purifying the living and working environment, however, the systems are expensive and operating costs accumulate, therefore it has not yet reached the point where they can be easily used in every household under the present circumstances. Accordingly, deodorants and odor-eliminating agents are locally placed in locations that have particularly strong offensive odors (toilet room and inside the refrigerator), however, the condition is far from total deodorization and purification of the entire house or office.

Means for solving the problems

As a result of repeated concentrated research to solve the aforementioned existing problems in waterproofing and deodorizing (air purifying) houses and offices, it has been discovered in this invention that a flexible waterproof sheet can be obtained, having an improved waterproof-band-forming capacity displaying not only fixation and stabilization of highly water-absorbent gelling substance, but also unexpectedly displaying excellent moisture permeability and water absorption through fixation and formation of a layer of highly water-absorbent gelling substance in granular form, with a composition of ferrous sulfate and L-ascorbic acid, between laminated layers of material penetrable by water with an adhesive material, and also that this sheet

displays an excellent deodorizing function, resulting in this invention based on this knowledge.

More precisely, this invention provides a waterproofing and deodorizing sheet material characterized by adhering and fixing highly water-absorbent gelling substance in granular form composed of an iron(II) compound combined with L-ascorbic acid, between sheets of material penetrable by water.

Application examples

Next, this invention will be explained in an application example illustrated in the figures. Figure 1 shows a cross-sectional view of the sheet material of this invention. In the figure, (1) is a material sheet penetrable by water, such as nonwoven fabric, for example, (2) is a waterproof adhesive on the surface, (3) is a highly water-absorbent gelling substance in granular form with the aforementioned composition, being an iron(II) compound combined with L-ascorbic acid, (4) is a waterproof adhesive on top of a material sheet penetrable by water (5), such as nonwoven fabric, for example, and (6) is waterproof material.

Woven fiber or paper consisting of natural fiber or synthetic fiber or their combination can certainly be used instead of the aforementioned nonwoven fabric as the material sheet penetrable by water in this invention, or a synthetic resin sheet perforated with many small holes can be used.

Bentonites, for example, are suitable as the highly water-absorbent gelling substance. However, any nontoxic substance which absorbs water to expand and form a waterproof layer can be

used without being restricted to inorganic or organic substances. Besides bentonite in the montmorillonite group atapulgite, [sepiolite], other natural products, and synthetic inorganic substances can be used as examples of the inorganic highly water-absorbent gelling substance. Polyacrylic water-soluble salt, polyvinyl alcohol, polyacrylonitrile, polyvinyl acetate, their copolymers, and high-molecular-weight substances, such as CMC, for example, can be used as the organic substances. Furthermore, those with sodium compound and magnesium compound added to increase swelling are ideal, as bentonite in the montmorillonite group. These can be used alone or as mixtures. The aforementioned inorganic substances and organic substances can certainly be mixed for use. The specific gravity of the aforementioned inorganic substances is relatively high and the specific density of the organic substances is relatively small, therefore, the weight of the sheet material can be adjusted by mixing them together for use. Moreover, the swelling percentage of the inorganic substance is approximately 3-5 times, however, the swelling percentage of the organic substance is relatively high (10-50 times, for example), therefore the thickness of the waterproof layer can be controlled by mixing the organic and inorganic [substances] together for use.

The aforementioned highly water-absorbent gelling substance is used in granular form. The diameter of the particles is generally in the range of 0.1-10 mm, ideally 0.3-3 mm. The water-stopping effect is not sufficient when the diameter of the particles is less than 0.1 mm because the layer becomes too thin, however, expansion by absorbing water slows when it exceeds 10 mm. These granulated substances can be obtained through

extrusion granulation, fluidized bed granulation, rolling granulation, and other methods, or natural products processed by crushing can be used. The particles can certainly be any shape, cylindrical, spherical, or other shapes, as long as the particles can be distributed over the material penetrable by water in a uniformly thick layer.

Any type of adhesive can be used as the adhesive for securely fixing the highly water-absorbent gelling substance as long as the adhesive fixes the highly water-absorbent gelling substance on the material sheet penetrable by water. It is not particularly restrictive, however, a waterproof and flexible adhesive with [sufficient] adhesive strength, which does not dissolve in water, is ideal. Adhesives such as polyvinyl ether, polyisobutylene, SBR, butyl rubber, polyurethane, chloroprene, and nitrile rubber, for example, can be used. The adhesive should be applied in an amount sufficient for fixing the highly water-absorbent gelling substance but without preventing water absorption.

Next, the composition (abbreviated as the "iron(II) compound composition" below) contained in the highly water-absorbent gelling substance, in which an iron(II) compound is combined with L-ascorbic acid, will be explained.

Deodorization is effective when the molar ratio of the iron(II) compound and L-ascorbic acid in the iron(II) compound composition is approximately 1:1, however it is ideal when it is within the range of 1:0.05-1:0.001. Activity (deodorization effect, for example) decreases when L-ascorbic acid exceeding this range is used, but the stabilizing effect does not expectedly increase although cost increases. The activity

becomes low and sufficient stability is not obtained when L-ascorbic acid is less than the lower limit of the aforementioned range.

The iron(II) compound must be combined with the L-ascorbic acid in the iron(II) compound composition. This can be attained in the form of an aqueous solution in which both components are mixed and dissolved, or in powdered form, in which the aforementioned aqueous solution is dried through spray drying and freeze drying, for example.

Besides the iron(II) inorganic salts, such as ferrous sulfate, ferrous chloride, ferrous nitrate, ferrous bromide and ferrous iodide, for example, iron(II) organic salts, such as ferrous gallic acid, ferrous malic acid and ferrous fumaric acid, for example, can be used as examples of the iron(II) compound used in the iron(II) compound composition. The iron(II) compound should not be restricted to those examples listed above but optional types can be used if they dissolve and form divalent iron ions in water.

In order for the aforementioned highly water-absorbent gelling substance in granular form to contain this iron(II) compound, the granulated substance obtained can be soaked in the iron(II) compound which is in an aqueous solution, or it can be added or kneaded as an aqueous solution or powder during mixing and kneading for granulation.

The amount of the iron(II) compound composition contained in the highly water-absorbent gelling substance in granular form is not particularly restrictive; however, it is recommended for it to be in the range of up to 20 wt%, ideally in the range 1-10 wt%.

The waterproofing and deodorizing material sheet in this invention can be manufactured in the following manner, for example.

In Figure 1, the highly water-absorbent gelling substance in granular form (3) is minutely and uniformly distributed on top of the adhesive (2) over the material sheet penetrable by water (1) treated for adhesion by thinly coating the adhesive (2), the material sheet penetrable by water (5), which is similarly treated for adhesion with the adhesive (4), is laminated to it, pressure is applied with rollers, and a waterproofing and deodorizing material (6) is obtained by completely fixing the material sheets penetrable by water (1) and (5) with the highly water-absorbent gelling substance in granular form (3). An example of the waterproofing and deodorizing sheet material obtained in this manner is indicated in a diagonal view in Figure 2. A condition in which this waterproofing and deodorizing sheet material is rolled in a roll is indicated in the same figure. The thickness of this waterproofing and deodorizing material is not particularly restrictive; however, it is generally recommended that it to be in the range of up to 10 mm.

Also, the sheet material in this invention is not restricted to the structure type shown in the figure. Different types of woven fabric, paper, synthetic resin material can be laminated on the surfaces using the aforementioned as a core.

i. Waterproof test

The waterproofing and deodorizing sheet indicated in Figure 1 was manufactured in the following manner. A band-shaped

nonwoven fabric made of synthetic fiber at a width of 1 m and length of 10 m was used as the material sheet penetrable by water (1), and the adhesive (2) (rubber adhesive) was coated onto it. Successively, bentonite in granular form, processed through granulation into a cylindrical shape with a diameter of 1.2 mm and length 0.3-3 mm, was minutely distributed in a uniform thickness on top of the adhesive over the nonwoven fabric to form a layer of highly water-absorbent gelling substance (3). Then, nonwoven fabric as the material penetrable by water (5) was laminated with the adhesive (4), pressure was applied with rollers to completely fix the nonwoven fabric and bentonite to obtain a waterproofing and deodorizing sheet at a thickness of 1.5 mm.

Next, this waterproofing and deodorizing sheet was installed in a pressure filter as a filtration film, and the amount of water leakage was measured to test its waterproofing effectiveness. It was observed that it expanded as the addition of water began to form a waterproof layer at a thickness of 3.2 mm which withstood a water pressure of 2.0 kg/cm^2 (depth of water was approximately 20 m).

The bentonite in granular form and the iron(II) compound/L-ascorbic acid composition contained within it, used previously, were prepared using the methods described below.

Preparation of the bentonite in granular form

Four parts by weight of sodium carbonate and 1.0 part by weight of magnesium chloride were mixed with 100 parts by weight

of natural calcium bentonite. The iron(II) compound, manufactured in the manner described later, at approximately 10 wt% of the powdered composition, was added to this, water was added, then it was kneaded and granulated (water content in the granular mass at 28 wt%), particles with a particle diameter of 1.2 mm (water content at 10 wt%) were obtained.

Preparation of the iron(II) compound in granular form

Ferrous sulfate ($FeSO_4 \cdot 7H_2O$) and L-ascorbic acid ($C_6H_8O_6$) were mixed together at a molar ratio of 1:0.01 and prepared as a dissolved aqueous solution (concentration at approximately 28% of a total amount of ferrous sulfate and L-ascorbic acid). 500 g of said aqueous solution were spray-dried using a spray dryer (DL-21 manufactured by Yamato Chemical K.K.) under the conditions listed below, and the composition in the powdered form (pH approximately at 3.0) was obtained, in which ferrous sulfate and L-ascorbic acid were combined.

Operating conditions
Fluid supplying rate: 40 mL/min
Flow rate of spray air: 15 L/min
Flow rate of dry air: 6 m^2/min
Inlet temperature: 120°C
Outlet temperature: 75°C

Table I

試験番号 (1)	加水前の防水脱臭シートの厚さ (mm) (2)	圧力 (kg/cm) (3)	加水後の防水層の厚さ (mm) (4)	漏水量 (cc/m²分) (5)
1	ブランク 0.4 (6)	0.5	0	(7) 止水効果全くなし 数秒で2 ℓの水全通
2	1.5	1.0	3.2	(8) 漏水全くなし 0
3	1.5	2.0	3.2	(9) 漏水全くなし 0 (10)
4	1.5	2.5	3.2	漏水あり 700cc/m・分

Key:
1 Test No.
2 Thickness of the waterproofing and deodorizing sheet before the addition of water (mm)
3 Pressure (kg/cm)
4 Thickness of the water-resistant layer after the addition of water (mm)
5 Amount of water leakage ($cc/m^2 \cdot min$)
6 Blank
7 No water-stopping effect, 2 L of water penetrated completely through in several seconds
8 No water leakage
9 Water leakage was observed, 700 cc/m·min

Also, the water absorption property of the waterproofing sheet obtained in the aforementioned manner was measured; the water-absorbing speed was relatively high and indicated a water absorption coefficient near the saturated condition just as water was added. The amount of water absorption was 5-6 L/m^2 indicating a high water absorption property.

ii. Deodorization test

The waterproofing and deodorizing sheet (test No. 3) used in the aforementioned waterproof test was air dried and its deodorizing performance was tested. The results are contained in Table II.

Testing method

As indicated in Figure 3, a closed system was constructed by placing 2 L of odiferous gas (hydrogen sulfide, ammonia, trimethylamine) G in a [Tedlar] bag A, placing a 100 mm x 100 mm waterproofing and deodorizing sheet S in a deodorizing tank B, circulating the odiferous gas within at a flow rate of 2 L/min by a pump P. The concentration of the odiferous gas within was measured after 15 min. A vacuum gas detecting tube was used for measurement.

Table II

試験番号 (1)	臭気物質 (2)	脱臭前のガス濃度 (p.p.m.) (3)	脱臭後のガス濃度 (p.p.m.) (4)
1	硫化水素 (5)	13500	3500
2	アンモニア (6)	40000	75
3	トリメチルアミン (7)	480	14

Key: 1 Test No.
2 Odiferous substance

3 Concentration of the gas before deodorization (ppm)
4 Concentration of the gas after deodorization (ppm)
5 Hydrogen sulfide
6 Ammonia
7 Trimethylamine

Results of the invention

The sheet material in this invention itself is permeable and excels in deodorization, as well as having excellent water absorption, and expands immediately upon absorption of water to form a completely waterproof layer. Moreover, this is an entirely new sheet material possessing both waterproofing and moisture permeability functions which may appear to be conflicting.

Accordingly, complete waterproofing can be attained by simply installing it in the floors in houses and offices. Then, accidents can be prevented in which water leakage upstairs extends to the downstairs rooms, damaging furniture and appliances, for example. More precisely, not only can fixation and stability of the highly water-absorbent gelling substance be attained but the water absorption excels because the granulated substance, instead of a powdered form, is securely fixed, displaying an outstanding effect of forming a minute waterproof layer through rapid absorption of water and expansion. Moreover, [the sheet] itself can eliminate offensive odors, such as ammonia, hydrogen sulfide and mercaptan, for example, very effectively, and constantly maintains clean air in rooms.

The sheet material in this invention generally has a structure in which the granulated substance spread all over is

moisture- and air-permeable, without creating the problem of dew condensation. Expansion through water absorption is reversible, air permeability is regained after drying and an excellent deodorizing function can be displayed. Many deodorizing agents lose their deodorizing activities once becoming wet with water, however, this point in which the deodorizing function is displayed again after drying is one of the characteristics of this invention, which is considered as a factor also for use as a waterproof material. The sheet material in this invention also has a bactericidal action and fungicidal effect. The aforementioned sheet material in this invention is suitably used in general construction, and also as floor material in locations where offensive odors in particular are easily generated, as well as where water is used, such as kitchens, bathrooms and toilet rooms, for example.

A layer of highly water-absorbent gelling substance in a uniform thickness is adhered to and formed between two sheets having the water penetrable property in this invention, which has excellent flexibility and can be rolled into a roll. The highly water-absorbent gelling substance between the material sheets penetrable by water does not drop out when the sheet material is cut into appropriate sizes at installation. Accordingly, it can be cut into optional sizes and installed at specific leakage areas with ease of handling and excellent workability. Also, this sheet material does not require seaming, for example, during manufacturing, and can be secured by an adhesive, which effectively reduces the manufacturing cost.

Brief explanation of the figures

Figure 1 is a cross-sectional view of the waterproof material in this invention in an application example. Figure 2 is a diagonal view of the same cut off at a section. Figure 3 is a diagram which explains the deodorization testing system.

1, 5··· material sheets penetrable by water

2, 4··· adhesives

3··· highly water-absorbent gelling substance

6··· waterproofing and deodorizing sheet

Redrawing of the figures (contents are not changed)

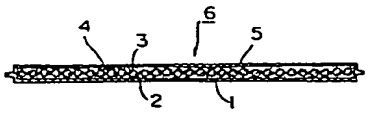

Figure 1

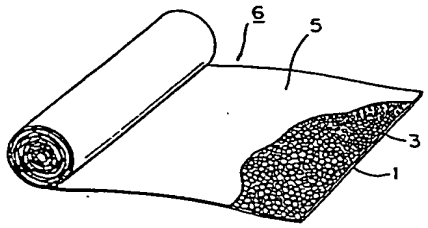

Figure 2

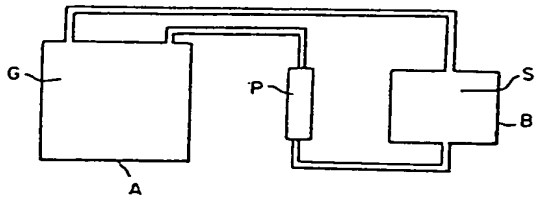

Figure 3